

Introduction of Actuator

An **actuator** is a device that converts **electrical energy into mechanical energy** to produce physical movement. It receives a control signal from a controller such as the **CPX** and performs an action based on the program.

How Actuators Work

An actuator generally works through the following process:

Control Signal → Actuator → Energy Conversion → Mechanical Movement

- The **CPX** sends a control signal according to the program.
- The actuator receives the required electrical power.
- Internal components respond to the control signal.
- Electrical energy is converted into mechanical energy.
- The actuator produces the required movement.

The type and amount of movement depend on the actuator being used.

Actuators in a Robotic System

Actuators are the **output devices** of a robot.

For example, when a sensor detects an object:

Sensor detects → CPX processes → CPX sends command → Actuator moves

This allows the robot to respond to its surroundings and perform physical actions.

Servo Motor

A **servo motor** is an actuator designed for **controlled angular movement**.

The controller sends a control signal to the servo. The servo's internal control system uses this signal to move the shaft towards the required position.

Example: MG996R

CPX → Control Signal → MG996R Servo → Shaft Movement

The MG996R can be used to move a robotic arm, gripper, or joint to a required position.

Working

1. CPX sends a control signal.
2. Servo receives the signal.
3. The internal control circuit processes the signal.

4. The motor and gears rotate the shaft.
 5. The shaft moves towards the required position.
-

Stepper Motor

A **stepper motor** is an actuator that produces rotation in **small, controlled steps**.

The motor contains coils that are energized in a specific sequence. This sequence causes the rotor to move from one position to the next.

Example: 28BYJ-48

CPX → Control Signals → Motor Driver → 28BYJ-48 → Step-by-Step Rotation

A suitable motor driver is used to control the stepper motor coils.

Working

1. The controller sends a sequence of signals.
 2. The driver switches the motor coils.
 3. The coils create magnetic fields.
 4. The rotor moves to the next position.
 5. Repeating the sequence produces controlled rotation.
-

Servo Motor vs Stepper Motor

Servo Motor	Stepper Motor
Moves to a required angular position	Moves in controlled steps
Example: MG996R	Example: 28BYJ-48
Suitable for robotic joints and arms	Suitable for controlled positioning
Uses a control signal for position	Uses a sequence of signals

Key Point

An actuator converts **electrical energy into mechanical movement**.

Sensor → Detects

Controller → Decides

Actuator → Acts

Therefore, actuators are essential for enabling robots to **move, interact, and perform physical actions**.